

LEPIDOPTERA ASSOCIATED WITH GREENLEAF MANZANITA,
ARCTOSTAPHYLOS PATULA E. GREENE (ERICACEAE), IN
SHASTA COUNTY, CALIFORNIA

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Abstract.—Fifty lepidopteran taxa were collected in association with greenleaf manzanita. Of these, 31 were collected from manzanita foliage as larvae and 29 were reared to adulthood. A listing of taxa is presented including method of collection, life stage(s) encountered in the field, collecting locations, and parasitoids reared from collected specimens.

Key Words: Lepidoptera, *Arctostaphylos patula*, greenleaf manzanita, parasitoids

Greenleaf manzanita, *Arctostaphylos patula* E. Greene (Ericaceae), is a broadleaf evergreen shrub that commonly occurs in the Sierra Nevada mountain range of the western United States (Hickman 1993). This particular manzanita species grows in mesic habitats associated with montane forest zones generally above 303 m (1000 ft) in elevation (Ball et al. 1983). In general, information concerning insects and brushfield ecosystems (e.g. montane chaparral communities) is currently lacking in the literature (Force 1990); this is certainly the case concerning herbivorous insects associated with greenleaf manzanita (e.g. Haws et al. 1988). In response to the growing concern over a limited number of control options for greenleaf manzanita shrubs which compete with more economically important timber species, a study was conducted from 1989 to 1994 to evaluate the potential of using native insects to alter vegetative composition (Valenti 1994). More than 500 insect species were identified in association with greenleaf manzani-

ta. In this paper we present results of the Lepidoptera inventory. This list includes important host information on many species for which virtually nothing is known. In addition, records of parasitoids and other natural enemies, when available, are presented for a number of species.

MATERIALS AND METHODS

Site descriptions.—Bear Wallow. This 20+ ha, old-growth greenleaf manzanita brushfield (elevation 1524 m [5000 ft]) is located 3 km (by dirt road) from CA Route 89 in Old Station (approximately 6.6 km south southwest of the Logan Lake site) (T32N R4E S10). Greenleaf manzanita, which averaged 1.5–2.0 m in height, accounted for approximately 85% of the total vegetation.

Hat Creek. Located adjacent to the USDA Forest Service Work Center, Hat Creek, CA (T34N R4E S16) (elevation 1018 m [3340 ft]), this site consists of a variety of woody plant species. Greenleaf manzanita is fairly common but accounted for less than 30% of the total vegetation. Other plant species present at this site included: sagebrush (*Artemisia tridentata*

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Nuttall) (Asteraceae); curl-leaf mountain-mahogany (*Cercocarpus ledifolius* Nuttall), birch-leaf mountain-mahogany (*C. betuloides* Torrey & A. Gray), and antelope bitterbrush (*Purshia tridentata* [Pursh] de Candolle) (Rosaceae); California black oak (*Quercus kelloggii* Newberry) (Fagaceae); and a mixture of conifers including ponderosa pine (*Pinus ponderosa* Lawson), sugar pine (*P. lambertiana* Douglas), white fir (*Abies concolor* [Gordon & Glendinning] Lindley), Douglas-fir (*Pseudotsuga menziesii* [Mirbel] Franco), incense cedar (*Calocedrus decurrens* [Torrey] Florin), and western juniper (*Juniperus occidentalis* Hooker) (Pinaceae).

Logan Lake. This site (elevation 1512 m [4960 ft]) is located 3.2 km (by dirt road) northwest of CA Route 89 in Old Station, approximately 24 km south of Hat Creek, CA (T32N R4E S2&3). Dominant vegetation consisted of greenleaf manzanita (74%), tobacco brush (*Ceanothus velutinus* Hooker) (Rhamnaceae) (11%), and ponderosa pine (9%). The 50+ ha site is located 1.6 km west of Logan Lake on an east-facing slope and was mechanically cleared of all standing vegetation in 1976 and planted to ponderosa pine the following year. Greenleaf manzanita shrubs averaged 1.5–2.0 m in height.

Tamarack Swale. In 1974, this 25+ ha site was mechanically cleared and ponderosa pine seedlings were planted in 1975. The site is located in a valley 6.4 km (by dirt road) southwest of CA Route 89 approximately 5 km south of Hat Creek (T33N R4E S4&9) (elevation 1646 m [5400 ft]). Tobacco brush (16%) and ponderosa pine (8%) were interspread with the dominant species, greenleaf manzanita (61%). Greenleaf manzanita shrubs were removed again in 1984 during a second mechanical clearing treatment, however, shrubs subsequently became reestablished and averaged 0.75 m in height.

Other location. In May 1991, a localized outbreak of a tussock moth (Lymantriidae) was discovered in Redding, California, at

the junction of Hilltop Drive and California Route 44. Larvae were actively feeding on an ornamental manzanita, *Arctostaphylos densiflora* Baker, and several dozen were subsequently transferred to caged *A. patula* plants at the Hat Creek Forest Insect Laboratory.

Arthropod survey.—Lepidoptera were sampled by visually searching and hand picking individuals from plants, sweeping foliage with a canvas net, and Malaise trapping (at the Logan lake site only). Generally, collecting began in May and ended in August for the years 1989 to 1994. Adult specimens collected in the field were transported to the USDA Forest Service, Forest Insect Laboratory, Hat Creek, CA, for preparation. All adult specimens were pinned and labelled with complete collecting information. Voucher specimens are deposited in the Maurice T. James Entomological Collection, Department of Entomology, Washington State University, Pullman.

Attempts were made to rear all encountered immatures to adults. Individual larvae were placed in small plastic containers or screen cages with host material and allowed to develop and pupate. Many pupae required a cold treatment (e.g., 90 d at 4°C) before adults emerged. Parasitic flies (Diptera) and wasps (Hymenoptera) were collected from these larval rearings.

RESULTS

Following the scientific name of each species is the method of collection (Hp—hand picking, Sw—sweeping foliage, or Mt—Malaise trap), stage(s) encountered (E—egg, L—larva, P—pupa, A—adult, and rA—reared adult), and collection location (BW—Bear Wallow, HC—Hat Creek, LL—Logan Lake, TS—Tamarack and Swale, and OL—other location). Greenleaf manzanita is the host for 31 of the species collected and, unless otherwise noted, apparently represent new host records. None of the hymenopteran parasitoids encountered in this study are listed in the comprehensive catalog by Krombein et

al. (1979) and just two tachinid (Diptera) parasitoid records (as noted) have previously been reported (Arnaud 1978). Accounts of spider (Araneae) predation on larvae of a geometrid are also new. Distributional records are included for an additional 19 species of Lepidoptera collected in association with greenleaf manzanita brushfield communities (18 as adults and one as a chrysalis and reared to adulthood).

GREENLEAF MANZANITA HOST RECORDS

Psychidae

Hyaloscotes fumosa Butler: Hp; L, rA; HC

Gracillariidae

undet. genus and species (serpentine mine): Hp; L; BW, HC, LL, TS

undet. genus and species (blotch mine): Hp; L; BW, HC, LL, TS

Coleophoridae

Coleophora glaucella Walsingham: Hp; L, rA; BW, HC, LL, TS

Related host record: *Arctostaphylos glaucella* Lindley (Walsingham 1882)

This casebearer is also known to feed on other manzanita species including *A. insularis* E. Greene, *A. viscida* C. Parry, and *A. patula* (J.-F. Landry, pers. comm.).

Parasitoids reared from larvae:

Agathis sp. (Hymenoptera: Braconidae): HC

Chelonus sp. (Hymenoptera: Braconidae): HC

Gelechiidae

Gelechia panella Busck: Hp; L, rA; HC, LL

Pseudochelaria manzanitae (Keifer): Hp; L, rA; HC, LL, TS

Related host record: *Arctostaphylos* sp. (Duckworth 1964)

Parasitoid reared from larvae:

Erynnia tortricis (Coquillett) (Diptera: Tachinidae): HC

Tortricidae

Amorbia cuneana (Walsingham): Hp; L, rA; HC

Choristoneura sp. (*rosaceana* [Harris] species complex): Hp; L, rA; HC

Parasitoids reared from larvae (†also listed in Arnaud [1978]):

Erynnia tortricis (Coquillett) (Diptera: Tachinidae): † HC

Eumea caesar (Aldrich) (Diptera: Tachinidae): † HC

Nilea or *Lespesia* sp. (Diptera: Tachinidae): HC

Epinotia arctostaphylana (Kearfott): Hp; L, rA; LL

Related host record: *Arctostaphylos uva-ursi* L. (Dyar 1904)

E. miscana (Kearfott): Hp; L, rA; LL, TS

E. subplicana (Walsingham): Hp; L, rA; LL

Related host record: *Arctostaphylos manzanita* C. Parry (Heinrich 1923)

E. terracoctana (Walsingham): Hp; L, rA; LL

Lycanidae

Incisalia augustus iroides (Boisduval): Hp; L, rA; HC, LL

Related host record: *Arctostaphylos uva-ursi* L. (Scott 1986)

Geometridae

Aethaloida packardaria (Hulst): Hp; E, L, rA; HC, LL

Several generations of this species were also reared through on kinnikinnick, *Arctostaphylos uva-ursi* L.

Anacamptodes clivinaria clivinaria (Guenée): Hp; L, rA; LL

Eupithecia sp.: Hp; L, rA; HC

Hesperumia fumosaria impensa Rindge: Hp; L, rA; BW, HC, LL, TS

Larval habits were previously unknown. Late larval instars occur in three distinct color morphs which mimic host stems. A yellow-green morph with a dorsal crimson stripe and a uniformly crimson morph occur on greenleaf manzanita. The third morph is mottled gray and occurs on antelope bitterbrush.

Parasitoids reared from larvae:

Deopalpus sp. nr *contiguus* (Reinhard) (Diptera: Tachinidae): HC

Madremyia saundersii (Williston) (Diptera: Tachinidae): HC

Phryxe pecosensis (Townsend) (Diptera: Tachinidae): HC

Aleiodes nolophanae (Ashmead) (Hymenoptera: Braconidae): HC

Nemoria glaucomarginaria (Barnes & McDunnough): Hp; L, rA; LL

Porter (1986) reported that wild collected larvae are unknown. He collected ova from wild female moths and reared larvae on California live oak, *Quercus agrifolia* Née, California white oak, *Q. lobata* Née, and cork oak, *Q. suber* L. (Fagaceae). Larvae we collected from greenleaf manzanita plants have dorsolateral projections, and late instars mimic greenleaf manzanita inflorescence stems both in coloration (yellow, green, and red) and physical appearance.

Synaxis cervinaria (Packard): Hp; E, L, rA; BW, HC, LL, TS

Larval habits were previously unknown. Mature larval coloration varies from dark gray to crimson (often mottled). Larvae mimic stems and twigs of greenleaf manzanita shrubs (see Valenti [1994] for complete descriptions of all life stages and life history).

Parasitoids reared from eggs:

Trichogramma sp. (Hymenoptera: Trichogrammatidae): HC, LL

Telenomus alsophilae Viereck (Hymenoptera: Scelionidae): HC, LL

Parasitoids reared from larvae:

Campylochaeta sp. (Diptera: Tachinidae): LL

Aleiodes n. sp. (Hymenoptera: Braconidae): LL

Meteorus rubens (Nees) (Hymenoptera: Braconidae): LL

Dusona nigrifibialis (Viereck) (Hymenoptera: Ichneumonidae): LL

Euplectrus sp. (Hymenoptera: Eulophidae): LL

Parasitoid observed in the field attacking larval instar III:

Goniozus gracilicornis (Kieffer) (Hymenoptera: Bethyliidae): HC

Predators observed in the field attacking larvae:

Misumenops celer (Hentz) (Araneae: Thomisidae): LL

Xysticus sp. (Araneae: Thomisidae): LL

Metaphidippus sp. (Araneae: Salticidae): LL

Lasiocampidae

Malacosoma californicum (Packard): Hp; L, rA; HC, LL

M. constrictum (Henry Edwards): Hp; L, rA; HC

M. disstria Hübner: Hp; L, rA; HC

Phyllodesma americana (Harris): Hp; L, rA; LL

Lymantriidae

Orgyia cana Henry Edwards: Hp; L, rA; OL

Larvae were collected from Vine Hill manzanita, *Arctostaphylos densiflora*, in Redding, California, and reared to adulthood on greenleaf manzanita at Hat Creek; a subsequent generation was also reared through to adulthood with greenleaf manzanita as host.

Saturniidae

Hemileuca eglanterina shastaensis (Grote): Hp; L, rA; HC, LL

Related host record: *Arctostaphylos* sp. (Packard 1914)

Hyalophora euryalus (Boisduval): Hp; E, L, rA; HC, LL

Related host record: *Arctostaphylos* sp. (Collins and West 1961)

Saturnia mendocino Behrens: Hp; E, L, rA; LL, TS

Related host record: *Arctostaphylos tomentosa* (Pursh) Lindley (Edwards 1880)

Parasitoid reared from larvae:
Lespesia sp. (Diptera: Tachinidae): LL

Sphingidae

Sphinx vashii Strecker: Hp; L, rA; HC

Noctuidae

Acronicta ? perdita Grote: Hp; L, rA; LL

Apharetra californiae McDunnough: Hp; L, rA; LL

Parasitoid reared from larvae:
Periscepsia helymus (Walker) (Diptera: Tachinidae): LL

Aseptis ethnica Smith: Hp; L, rA; HC, LL

Parasitoid reared from larvae:
Periscepsia helymus (Walker) (Diptera: Tachinidae): LL

DISTRIBUTIONAL RECORDS

Hepialidae

Hepialis hectoides Boisduval: Hp; A; HC

Pyralidae

Tulsa ? oregonella (Barnes & McDunnough): Mt; A; LL

Hesperiidae

Hesperia sp.: Mt; A; LL

Nymphalidae

Nymphalis californica (Boisduval): Hp; P, rA, A; BW, HC, LL, TS

This species is known to feed on *Ceanothus* spp. and has been recorded on other shrubs including *Arctostaphylos* (Furniss and Barr 1975). Adults were fairly commonly encountered and a single chrysalis was found attached to a leaf in a clump of isolated greenleaf manzanita shrubs growing in a gravel pit at the Hat Creek site.

Geometridae

Apodrepanulatrix litaria (Hulst): Sw; A; LL

Chlorosea nevadaria Packard: Sw; A; HC

Cyclophora dataria (Hulst): Sw; A; LL
Drepanulatrix rectifascia (Hulst): Sw; A; LL

D. unicalcararia (Guenée): Sw; A; LL
Itame guenearia (Packard): Sw; A; HC
I. quadrilinearia (Packard): Mt; A; LL
Nemoria darwiniata (Dyar): Sw; A; HC, LL

Sabulodes edwardsata (Hulst): Mt; A; LL

Semiothisa signaria dispuncta (Walker): Mt; A; LL

Sericosema juturnaria (Guenée): Sw; A; HC

S. wilsonensis (Cassino & Swett): Mt; A; LL

Sphingidae

Hyles lineata (F): Mt; A; LL

Paonias myops (J.E. Smith): Hp; A; HC

Several adults were collected on the inside of an 8 × 8 m bird enclosure (with 1.5 × 1.5 cm openings) containing only greenleaf manzanita. It is doubtful these adults came from outside the enclosure because they were larger than the net openings. It is quite conceivable that larvae fed on greenleaf manzanita and pupated inside the enclosure. Adults that subsequently emerged became trapped inside the enclosure netting.

Arctiidae

Spilosoma vestalis Packard: Sw; A; HC, LL

DISCUSSION

The information presented here represents the first in-depth study of the lepidopterous fauna associated with a manzanita species. In two general treatments of insects affecting important western trees and shrubs (Furniss and Barr 1975, Furniss and Carolin 1977), only four species of Lepidoptera are recorded feeding on *Arctostaphylos* spp.; *Nymphalis californica*, *Hemileuca eglanterina*, *Hyalophora euryalus*, and a species not encountered in our

study, *Orgyia vetusta gulosa* (Henry Edwards) (Lymantriidae). The collection and rearing of 29 species substantiates that a significant number of Lepidoptera utilize greenleaf manzanita as a host. Some of these species are certainly generalists (e.g., *Nymphalis californica*, *Malacosoma californicum*, *M. disstria*, and *Phyllodesma americana*) and manzanita may not necessarily be the primary host. For most cases, we have presented new records of larval rearings and host associations. Additionally, a number of new larval/parasitoid relationships were discovered through the rearings.

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